GUIDELINES FOR NANOTECHNOLOGY RESEARCH

1. Definition of Nanotechnology

1.1. Nanotechnology involves work with naturally occurring or engineered materials at dimensions between 1 and 100 nanometers. A nanometer is one billionth of a meter (1 nanometer = 10^-9 meter).

1.2. Engineered nanoparticles are manufactured within nanoscale dimensions.

1.3. Naturally occurring nanoparticles resulting from the fine crushing of minerals or fume production condensate.

2. Types of Nanomaterials

2.1. Nanoparticles consist of three types of materials (particles, tubes, and films) in which all three dimensions of the particle are within the nanoscale.

2.2. Nanotubes are carbon tubes that have a diameter of 1 to 2 nanometers and are measured in microns or micrometers in length.

2.3. Nanofilms, nanoplates, and nanowires have a thickness measured in nanometers and the other two dimensions that are measured in millimeters (or larger).

2.4. Commonly used materials include titanium dioxide, copper, gold, iron and silver nanoparticles

3. Notification of Environmental Health and Safety (EH&S) of Nanotechnology Work

3.1. All University of Pittsburgh researchers shall register all Nanotechnology work with EH&S. Registration can be completed through the EH&S website at the following link, http://www.ehs.pitt.edu/biological/workbook.html.

3.2. The Agent Registration Workbook contains the following five sections, each requiring specific information for completion:

3.2.1. Administrative – description of the nanotechnology project

3.2.2. Laboratory – description of laboratory location and equipment where nanotechnology work occurs and description of the work (ex. plasma etch, lithography, etc.)
3.2.3. Personnel – listing of research personnel working on nanotechnology project

3.2.4. Biological Agents – complete if biological agents are being used in nanotech project.

3.2.5. Chemical Agents – listing of hazardous chemical agents being used.

3.3. Two main versions of the workbook have been developed: a macro-enabled version for the PC and a non-macro version for the Macintosh.

4. Routes of Occupational Exposure

4.1. Skin Absorption – Certain nanoparticles can be absorbed through intact skin.

4.1.1. Researchers are required to wear gloves (latex or nitrile) during all handling of nanoparticles and nanomaterials.

4.1.2. Researchers are required to wear disposable Tyvek laboratory coats or cloth laboratory coats with disposable Tyvek or vinyl sleeves during all handling of nanoparticles and nanomaterials.

4.1.3. Laboratory Attire guidelines must also be followed. Consult EH&S Guidelines #03-001.

4.2. Ingestion – Nanoparticles can be ingested if proper handling procedures are not followed.

4.2.1. Eating, drinking, applying cosmetics, handling contact lenses is not permitted in the laboratory per University Guidelines.

4.2.2. Laboratory personnel should remove PPE when work with nanoparticles is completed and wash their hands.

4.3. Inhalation – Nanoparticles can be introduced to the respiratory system via inhalation of airborne particles.

4.3.1. Nanoparticles should be handled in solution or as part of a substrate whenever possible to minimize risk of inhalation.

4.3.2. Whenever possible, work with nanoparticles should be handled within a containment device such as a fabricated bench-top enclosure, chemical fume hood or fully exhausted biosafety cabinet (Class II, Type B2). Recirculating biosafety cabinets are not permitted to be used with nanomaterials (Type A cabinets).
4.3.3. Laboratory personnel should wear the appropriate respiratory protection (P-100 HEPA filtration) when working with nanoparticles outside of primary containment devices.

4.3.4. Individuals wearing P-100 respiratory protection must be enrolled in the University of Pittsburgh Respiratory Protection Program. Information on the Respiratory Program is available at the following link, [http://www. ehs.pitt.edu/assets/docs/ respiratory.pdf](http://www.ehs.pitt.edu/assets/docs/respiratory.pdf).

4.4. Injection – Nanoparticles can be introduced to the body via a needlestick.

4.4.1. Standard precautions should be followed when utilizing sharps with nanoparticles or nanomaterials.

4.4.2. EH&S recommends the use of Safety-Engineered Sharps devices during work with nanoparticles.

5. **Guidelines for Handling Nanoparticles in University Laboratories**

5.1. University Chemical Hygiene Plan (EH&S Guideline # 04-001, [http://www.ehs.pitt.edu/assets/docs/chem-hygiene-plan.pdf](http://www.ehs.pitt.edu/assets/docs/chem-hygiene-plan.pdf)) provides applicable guidelines for working with chemicals and should be followed by all research personnel utilizing nanomaterials in addition to the guidelines listed in this section.

5.2. Principal Investigator (PI) is responsible for developing and reviewing safe work practices with research personnel working with nanomaterials or within the same laboratory area that nanomaterials are handled.

5.3. PI must create a Standard Operating Procedure (SOP) for research work involving nanomaterials. The SOP must be available to all research personnel working with nanomaterials or within the same laboratory area that nanomaterials are handled.

5.4. PI is responsible for maintaining Safety Data Sheets (SDS) for all nanomaterials to be available and kept up to date within the laboratory in which nanomaterials are stored and used.

5.5. All manipulations of nanoparticles should occur in a dedicated chemical fume hood (annual certification of fume hood is required), hard ducted biological safety cabinet, glove bag, glove box or enclosed HEPA filtered glove box. Horizontal laminar flow hoods (with air flow directed toward worker) are NOT permitted to be used with nanomaterials.
5.6. Work with nanoparticles outside of an exhausted enclosure require researchers to wear a NIOSH-approved P-100 particulate respirator (annual EH&S approved fit-test is required).

5.7. Nanoparticles should be handled while in solution or part of a substrate to minimize airborne release.

5.8. All containers (primary, secondary, and tertiary if applicable) should be labeled with the full name of the nanomaterials (avoid abbreviations and acronyms). “Nano” should be used in the chemical name.

5.9. Sealed, secondary containers should be utilized to transport nanomaterials between laboratories and buildings.

5.10. Every effort should be made to prevent the release of nanoparticles into the environment. EH&S recommends the use of a sticky mat at the exit of lab spaces where nanoparticles are handled.

6. Guidelines for Disposal of Nanoparticles and Associated Hazard Waste Solutions

6.1. Since the toxicology and environmental fate of nanoparticles is still largely unknown, nanoparticle waste (solid material and liquids) should be managed through the University's Chemical Waste program. All wastes must be contained in a sealed container. Waste containers must be labeled with an orange chemical waste label. Contact EH&S at 624-9505 for further information about how to handle specific wastes.

6.2. Do not dispose of nanoparticle waste in regular trash or down the drain.

6.3. Collect nanoparticle waste in a sealable container that remains closed except when adding the waste.

6.4. Dispose of nanoparticle waste, including contaminated debris, as you would the base nano-material (i.e., carbon nanotubes should be disposed of as carbon)

6.5. If the nanoparticles are in solution, the solution should be managed accordingly (e.g., flammable solvents are handled as flammable waste materials).

6.6. All nanoparticle waste must be labeled with the base metal or solute and identified as containing trace nanomaterial

7. Guidelines for Nanomaterial Spill Clean-up

7.1. Secure area where spill occurred, restrict access to the area and notify others in the laboratory of the spill.
7.2. Dry nanomaterials should NOT be brushed or swept.

7.3. Spill cleanup should be done using a wet wipe method and/or HEPA-filtered vacuum.

7.4. Appropriate PPE (gloves, lab coat, and P-100 respirator) should be donned.

7.5. Spills of nanomaterials should be covered with a wet paper towel or bench paper.

7.6. Clean-up should begin from the outside of the spill and work inward.

7.7. All spill cleanup material should be collected in a leak proof plastic bag and should be disposed through the Chemical Waste Disposal Program.

7.8. Chemical Waste label should be placed on the plastic bag and “Nanomaterial Spill Cleanup Material” should be written on the label (along with specific chemical name).

7.9. In the event of a large spill, the spill area should be secured and EH&S should be contacted (412-624-9505).

8. Guidelines for Shipment of Nanomaterials

8.1. If nanomaterials are required to be shipped off of the University of Pittsburgh campus via an external shipment company (Ex. UPS or FedEx) then applicable DOT shipping regulations must be followed. Pitt EH&S should be contacted to assist in the shipment of nanomaterials.

8.2. If nanomaterials are transported to off campus locations via a personal vehicle then applicable DOT packaging requirements must be followed. Pitt EH&S should be contacted to assist in determining proper packaging of nanomaterials.

9. Resources

http://www.cdc.gov/niosh/topics/nanotech/